REMARKS

Applicant has carefully reviewed and considered the Office Action mailed on June 29, 2005, and the references cited therewith. In the Office Action, claims 1-21 and 23-37 were examined. Claims 1-21, 23, 25-35, and 37 were rejected. Claims 24 and 36 were objected to.

Claims 1-21 and 23-37 remain in this application.

102 Rejection of the Claims

Claims 1-11, 13, 17-21, 23, and 25-35 were rejected under 35 USC §102(b) as being anticipated by Roberts, et al., (U.S. Patent No.: 6,001,088, hereinafter "Roberts"). As the Examiner is aware, in order for a reference to properly anticipate a claim under 35 U.S.C. §102(b), "each and every element as set forth in the claim [must be] found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California,* 814 F.2d 628, 631 (Fed. Cir. 1987), cited in MPEP §2131. Applicant asserts that as previously presented, each and every element of claims 1-21, 23, 25-35, and 37 is not taught by Roberts, and thus respectfully requests the withdrawal of this rejection.

Independent claims 1, 18, 27, and 35 each state that the electrodes of the device incorporate an "electropositive or electronegative" material. *See, e.g.,* claims 1, 18, 27, and 35, *supra.* Applicant previously noted that the Roberts reference fails to teach the use of electropositive or electronegative materials. *See, e.g.,* Office Action Response filed February 16, 2005, page 12. In the pending Office Action, the Examiner responded to this argument, asserting that "[t]he examiner interpretation is that the metal electrodes are inherently electropositive and electronegative because of the ions that are in silver, platinum, and steel. These ions are what allow the metals to be conductive and thus act like an electrode. Without the electropositive and electronegative ions, the metal would not be able to act as a conductor and lose its ability to form a battery." Office Action, p. 4, paragraph 8. Applicant respectfully asserts that the examiner's interpretation of the terms "electronegative" and "electropositive" as used in the pending claims is incorrect and submits that in light of scientifically-accepted definition of the terms used in the claims, Roberts fails to teach the use of electronegative or electropositive materials, thus not properly anticipating the claims.

The CRC Handbook of Chemistry and Physics defines electronegativity as "[a] parameter originally introduced by Pauling which describes, on a relative basis, the power of an atom or

group of atoms to attract electrons from the same molecular entity." *See* page 2-45 of the CRC Handbook of Chemistry and Physics, 82nd Ed., 2001-2002, appended hereto as Exhibit A. This definition is expanded upon in an article from an online encyclopedia which notes that "[t]he reverse of electronegativity, the ability of an atom to lose electrons, is known as electropositivity." *See* "Electronegativity," article, Wikipedia.org, appended hereto as Exhibit B. As noted in this article, "each element has a characteristic electronegativity." This property generally decreases down the groups and increases across the periods of the periodic table, as shown in the periodic table found in Exhibit B. Decreases in electronegativity down groups are attributed to a tendency of the nuclear charge to have less effect on outermost electron shells, while increases in electronegativity across periods are attributed to non-metals tending to gain electrons and metals tending to lose them as each atom strives to "achieve a stable octet." Exhibit B. Thus, the electropositivity or electronegativity of an element is a characteristic of that element. As a further clarification to the Office Action, metals such as silver, platinum, and steel are conductive due to their structure composed of atoms that only loosely hold their outermost electrons. *See* "Metals" article, Exhibit C.

As previously discussed, Roberts teaches the use of platinum, silver, or stainless steel, and not the electropositive or electronegative materials taught and claimed in the present invention as argued in detail in the previous Response and Amendment. As a result, Roberts fails to anticipate the claims of the instant application, and Applicant respectfully requests the withdrawal of this rejection.

<u>103 Rejection of the Claims</u>

Claim 12 was rejected under 35 USC §103(a) as being unpatentable over Roberts in view of Haak et al., (U.S. Patent No.: 5,445,606, hereinafter "Haak"). Claims 14-16 and 37 were rejected under 35 USC §103(a) as being unpatentable over Roberts in view of Theeuwes et al., (E.P. 0 931 564, hereinafter "Theeuwes"). As with 35 U.S.C. §102 rejections, rejections under 35 U.S.C. §103(a) must teach each and every element of the claims. Since Roberts itself fails to teach each and every element of claims 1 and 35 from which rejected claims 12, 14-16, and 37 depend, and since Haak and Theeuwes were cited for their teachings of control circuits and

carbon electrodes, respectfully, Applicant asserts that this rejection is unsupported and respectfully requests its withdrawal.

Allowable Subject Matter

Claims 24 and 36 were objected to as being dependent upon a rejected base claim, but were indicated to be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Applicant thanks the Examiner for this finding, but asserts that in light of the arguments made above, claims 24 and 36 are allowable as currently written.

Conclusion

Applicant respectfully submits that the claims are in condition for allowance and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicant's attorney, Mr. Loren R. Hulse, as indicated below, at the Examiner's convenience to facilitate further prosecution of this application.

If necessary, please charge any additional fees or credit overpayment to Deposit Account No. 50-3586

Respectfully submitted,

By their Representatives,

Date December 22, 2005

By [signature]
Loren R. Hulse
Reg. No.: 46,784
Telephone No.: (801) 978-2186

CERTIFICATE UNDER 37 CFR 1.8: The undersigned hereby certifies that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail, in an envelope addressed to: Mail Stop Amendment, Commissioner of Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on this 22 day of December, 2005.

Loren R. Hulse

Name

[signature]

Signature

CRC Handbook of Chemistry and Physics

A Ready-Reference Book of Chemical and Physical Data

HANDBOOK OF CHEMISTRY AND PHYSICS
2001-2002
82nd
EDITION
CRC PRESS LLC

Editor-in-Chief

David R. Lide, Ph.D.
Former Director, Standard Reference Data
National Institute of Standards and Technology

CRC Press
Boca Raton London New York Washington, D.C.

Electron stimulated desorption (ESD) - See Techniques for Materials Characterization, page **12-1**.

Electron volt (eV)* - A non-SI unit of energy used in atomic and nuclear physics; equal to approximately 1.602177×10^{-19} J. The electron volt is defined as the kinetic energy acquired by an electron upon acceleration through a potential difference of 1 V. [1]

[redacted]

Electrophoresis - The motion of macromolecules or colloidal particles in an electric field. [3]

Emissivity (e)* - Ratio of the radiant flux emitted per unit area to that of an ideal black body at the same temperature. Also called emittance. [1]

Emu - The electromagnetic system of units, based upon the cm, g, and s plus the emu of current (sometimes called the abampere).

Enantiomers - A chiral molecule and its non-superposable mirror image. The two forms rotate the plane of polarized light by equal amounts in opposite directions. Also called optical isomers.

Energy (E, U)* - The characteristic of a system that enables it to do work.

Energy gap* - In the theory of solids, the region between two energy bands, in which no bound states can occur.

Enols, alkenols - The term refers specifically to vinylic alcohols, which have the structure $HOCR'=CR_2$. Enols are tautomeric with aldehydes (R' = H) or ketones (R' not equal to H). [5]

Enthalpy (H)* - A thermodynamic function, especially useful when dealing with constant-pressure processes, defined by $H = E + PV$, where E is energy, P pressure, and V volume. [1]

Enthalpy of combustion* - The enthalpy change in a combustion reaction. Its negative is the heat released in combustion.

Enthalpy of formation, standard* - The enthalpy change for the reaction in which a substance is formed from its constituent elements, each in its standard reference state (normally refers to 1 mol, sometimes to 1 g, of the substance).

Enthalpy of fusion* - The enthalpy change in the transition from solid to liquid state.

Enthalpy of sublimation - The enthalpy change in the transition from solid to gas state.

Enthalpy of vaporization* - The enthalpy change in the transition from liquid to gas state.

Entropy (S)* - A thermodynamic function defined such that when a small quantity of heat dQ is received by a system at temperature T, the entropy of the system is increased by dQ/T, provided that no irreversible change takes place in the system. [1]

Entropy unit (e.u.) - A non-SI unit of entropy, equal to 4.184 J/K mol.

Ephemeris time - Time measured in tropical years from January 1, 1900.

Epoxy compounds - Compounds in which an oxygen atom is directly attached to two adjacent or non-adjacent carbon atoms of a carbon chain or ring system; thus cyclic ethers. [5]

Equation of continuity - Any of a class of equations that express the fact that some quantity (mass, charge, energy, etc.) cannot be created or destroyed. Such equations typically specify that the rate of increase of the quantity in a given region of space equals the net current of the quantity flowing into the region.

Equation of state* - An equation relating the pressure, volume, and temperature of a substance or system.

Equilibrium constant (K)* - For a chemical reaction $aA + bB \rightleftharpoons cC + dD$, the equilibrium constant is defined by:

$$K = \frac{a_C{}^c \cdot a_D{}^d}{a_A{}^a \cdot a_B{}^b}$$

where a_i is the activity of component i. To a certain approximation, the activities can be replaced by concentrations. The equilibrium constant is related to $\Delta_r G°$, the standard Gibbs energy change in the reaction, by $RT \ln K = -\Delta_r G°$.

Equivalent conductance - See Conductivity, electrical.

Erg (erg) - A non-SI (cgs) unit of energy, equal to 10^{-7} J.

Esters - Compounds formally derived from an oxoacid RC(=O)(OH) and an alcohol, phenol, heteroarenol, or enol by linking, with formal loss of water from an acidic hydroxy group of the former and a hydroxy group of the latter. [5]

Esu - The electrostatic system of units, based upon the cm, g, and s plus the esu of charge (sometimes called the statcoulomb or franklin).

Ethers - Compounds with formula ROR, where R is not equal to H. [5]

Euler number (Eu) - A dimensionless quantity used in fluid mechanics, defined by $Eu = \Delta p/\rho v^2$, where p is pressure, ρ is density, and v is velocity. [2]

Eutectic - The point on a two-component solid-liquid phase diagram which represents the lowest melting point of any possible mixture. A liquid having the eutectic composition will freeze at a single temperature without change of composition.

Excitance (M) - Radiant energy flux leaving an element of a surface divided by the area of that element. [1]

Exciton - A localized excited state consisting of a bound electron-hole pair in a molecular or ionic crystal. The exciton can propagate through the crystal.

Exosphere - The outermost part of the earth's atmosphere, beginning at about 500 to 1000 km above the surface. It is characterized by densities so low that air molecules can escape into outer space.

Expansion coefficient - See thermal expansion coefficient.

Extended electron energy loss fine structure (EXELFS) - See Techniques for Materials Characterization, page **12-1**.

Extended x-ray absorption fine structure (EXAFS) - See Techniques for Materials Characterization, page **12-1**.

Extinction coefficient - See Absorption coefficient, molar.

F-Center - See Color center.

Fahrenheit temperature (°F) - The temperature scale based on the assignment of 32°F = 0°C and a temperature interval of °F = (5/9)°C; i.e., $t/°F = (9/5)t/°C + 32$.

Farad (F)* - The SI unit of electric capacitance, equal to C/V. [1]

Faraday constant (F)* - The electric charge of 1 mol of singly charged positive ions; i.e., $F = N_A e$, where N_A is Avogadro's constant and e is the elementary charge. [1]

Faraday effect* - The rotation of the plane of plane-polarized light by a medium placed in a magnetic field parallel to the direction of the light beam. The effect can be observed in solids, liquids, and gasses.

Fatty acids - Aliphatic monocarboxylic acids derived from or contained in esterified form in an animal or vegetable fat, oil, or wax. Natural fatty acids commonly have a chain of 4 to 28 carbons (usually unbranched and even-numbered), which may be saturated or unsaturated. By extension, the term is sometimes used to embrace all acyclic aliphatic carboxylic acids. [5]

Fermat's principle - The law that a ray of light traversing one or more media will follow a path which minimizes the time required to pass between two given points.

Fermi (f) - Name sometimes used in nuclear physics for the femtometer.

Fermi level - The highest energy of occupied states in a solid at zero temperature. Sometimes called Fermi energy. The Fermi surface is the surface in momentum space formed by electrons occupying the Fermi level.

Fermi resonance - An effect observed in vibrational spectroscopy when an overtone of one fundamental vibration closely coincides in energy with another fundamental of the same symmetry species. It leads to a splitting of vibrational bands.

Fermi-Dirac distribution - A modification of the Boltzmann distribu-

Electronegativity

From Wikipedia, the free encyclopedia.
(Redirected from Electropositive)

Electronegativity is a measure of the ability of an atom or molecule to attract electrons in the context of a chemical bond. The type of bond formed is largely determined by the difference in electronegativity between the atoms involved. Atoms with similar electronegativities will constantly 'steal' an electron from each other (often misleadingly referred to as 'sharing') and form a covalent bond. However, if the difference is too great, the electron will be permanently transferred to one atom and an ionic bond will form. Furthermore, if one atom pulls slightly harder than the other, a polar covalent bond will form.

The reverse of electronegativity, the ability of an atom to lose electrons, is known as electropositivity.

Two scales of electronegativity are in common use: the Pauling scale (proposed in 1932) and the Mulliken scale (proposed in 1934). Another proposal is the Allred-Rochow scale.

Pauling Scale

The **Pauling scale** was devised in 1932. On this scale, the most electronegative chemical element (fluorine) is given an electronegativity value of 3.98 (textbooks often state this value to be 4.0); the least electronegative element (francium) has a value of 0.7, and the remaining elements have values in between. On the Pauling scale, hydrogen is arbitrarily assigned a value of 2.1 or 2.2.

'*δEN*' is the difference in electronegativity between two atoms or elements. Bonds between atoms with a large electronegativity difference (greater than or equal to 1.7) are usually considered to be ionic, while values between 1.7 and 0.4 are considered polar covalent. Values below 0.4 are considered non-polar covalent bonds, and electronegativity differences of 0 indicate a completely non-polar covalent bond.

Mulliken Scale

On the Mulliken scale, numbers are obtained by averaging ionization potential and electron affinity. Consequently, the Mulliken electronegativities are expressed directly in energy units, usually electron volts. It was proposed by Robert S. Mulliken in 1934.

Electronegativity Trends

Each element has a characteristic electronegativity ranging from 0 to 4 on the Pauling scale. The most strongly electronegative element, fluorine, has an electronegativity of 3.98 while weakly electronegative elements, such as lithium, have values close to 1. The least electronegative element is francium at 0.7. *In general*, the degree of electronegativity decreases down the groups and increases across the periods, as shown below. Across a period, non-metals tend to gain electrons and metals tend to lose them due to the atom striving to achieve a stable octet. Down a group, the nuclear charge has less effect on the outermost shells. Therefore, the most electronegative atoms can be found in the upper, right hand side of the periodic table, and the least electronegative elements can be found at the bottom left. Consequently, *in general*, atomic radius decreases across the periodic table, but ionization energy increases.

→ Atomic radius decreases → Ionization energy increases → Electronegativity increases →

Group	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**

Period																		
1	H																	He
	2.20																	
2	Li	Be											B	C	N	O	F	Ne
	0.98	1.57											2.04	2.55	3.04	3.44	3.98	
3	Na	Mg											Al	Si	P	S	Cl	Ar
	0.93	1.31											1.61	1.90	2.19	2.58	3.16	
4	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
	0.82	1.00	1.36	1.54	1.63	1.66	1.55	1.83	1.88	1.91	1.90	1.65	1.81	2.01	2.18	2.55	2.96	3.00
5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
	0.82	0.95	1.22	1.33	1.6	2.16	1.9	2.2	2.28	2.20	1.93	1.69	1.78	1.96	2.05	2.1	2.66	2.6
6	Cs	Ba	*	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
	0.79	0.89		1.3	1.5	2.36	1.9	2.2	2.20	2.28	2.54	2.00	1.62	2.33	2.02	2.0	2.2	
7	Fr	Ra	**	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Uub	Uut	Uuq	Uup	Uuh	Uus	Uuo
	0.7	0.9																
Lanthanides	*	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu		
		1.1	1.12	1.13	1.14	1.13	1.17	1.2	1.2	1.1	1.22	1.23	1.24	1.25	1.1	1.27		
Actinides	**	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr		
		1.1	1.3	1.5	1.38	1.36	1.28	1.13	1.28	1.3	1.3	1.3	1.3	1.3	1.3			

Periodic table of electronegativity using the Pauling scale
See also Periodic table and Electropositivity

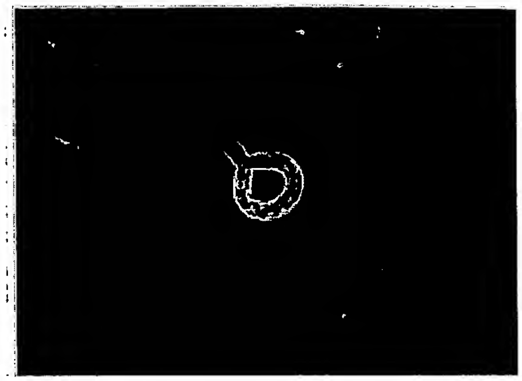
Category: Chemical properties

Metal

From Wikipedia, the free encyclopedia.

For alternative meanings see metal (disambiguation).

In chemistry, a **metal** (Greek: *Metallon*) is an element that readily forms ions (cations) and has metallic bonds, and metals are sometimes described as a lattice of positive ions (cations) in a cloud of electrons. The metals are one of the three groups of elements as distinguished by their ionisation and bonding properties, along with the metalloids and nonmetals. On the periodic table, a diagonal line drawn from boron (B) to polonium (Po) separates the metals from the nonmetals. Elements on this line are metalloids, sometimes called semi-metals; elements to the lower left are metals; elements to the upper right are nonmetals.



Hot metal work from a blacksmith

Look up *Metal* in Wiktionary, the free dictionary

Nonmetal elements are more abundant in nature than are metallic elements, but metals in fact constitute most of the periodic table. Some well-known metals are aluminium, copper, gold, iron, lead, silver, titanium, uranium, and zinc.

The allotropes of metals tend to be lustrous, ductile, malleable, and good conductors, while nonmetals generally speaking are brittle (for solid nonmetals), lack luster, and are insulators.

A more modern definition of metals is that they have overlapping conductance and valence bands in their electronic structure. This definition opens up the category for metallic polymers and other organic metals, which have been made by researchers and employed in high-tech devices. These synthetic materials often have the characteristic silvery-grey reflectiveness of elemental metals.

The properties of conductivity are mainly because each atom exerts only a loose hold on its outermost electrons (valence electrons); thus, the valence electrons form a sort of sea around the close-packed metal nucleii cations.

Most metals are chemically unstable, reacting with oxygen in the air to form oxides over varying timescales (iron rusts over years, potassium burns in seconds, silver tarnishes in months, although this is due to reactions with sulfur, although ozone, which is three atoms of oxygen bound together, can also play a part, as can hydrogen sulfide). The alkali metals react quickest followed by the alkaline earth metals, found in the leftmost two groups of the periodic table. The transition metals take much longer to oxidise (e.g. iron, copper, zinc, nickel), and palladium, platinum and gold do not react with atmospheric oxygen at all (which is why we make shiny jewelry from them). Some metals form a barrier layer of oxide on their surface which cannot be penetrated by further oxygen molecules and thus retain their shiny appearance and good conductivity for many decades (e.g. aluminium, some steels, titanium and more).

Painting or anodising metals are good ways to prevent their oxidation.

Contents

Alloys

An alloy is a mixture with metallic properties that contains at least one metal element. Examples of alloys are steel (iron and carbon), brass (copper and zinc), bronze (copper and tin), and duralumin (aluminium and copper). Alloys specially designed for highly demanding applications, such as jet engines, may contain more than ten elements.

Physical properties

Traditionally, metals have certain characteristic physical properties: they are usually shiny (they have "lustre"), have a high density, are ductile and malleable, usually have a high melting point, are usually hard, and conduct electricity and heat well. However, this is mainly because the low density, soft, low melting point metals happen to be reactive and we rarely encounter them in their elemental, metallic form. Metals are also sonorous, which means that they conduct sound well.

Metal oxides

The oxides of metals are basic; those of nonmetals are acidic.

Astronomy usage

In the specialised usage of astronomy and astrophysics, the term "metal" is often used to refer to any element other than hydrogen or helium. See metal-rich.

See also

- Screening
- Metallic bond
- Metal Working

Categories: Condensed matter physics | Metallic elements | Metals | Metalworking | Numismatics

---